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Training and Sports Sciences

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Effects of flat and uphill cycling on the power duration relationship

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Introduction:

- Coaches´ experience: power output during uphill cycling is higher than during flat cycling
- Just a few studies regarding this topic – controversial results
- Lots of influencing factors on power output (upper body position, cadence)
- Aim of the study: To investigate possible differences between flat and uphill cycling regarding CP/W´

(Barker et al., 2006; Bouillod et al., 2017; Carnevale & Gaesser, 1991; Gnehm et al., 1997; Jobson et al., 2008; Nielsen et al., 2004; Nimmerichter et al., 2012; Sassi et al., 2005; Welbergen & Clijsen, 1990)

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Methods:

- 13 endurance-trained subjects (experienced in TT and field tests – learning effect)
- Graded Exercise Test (GXT)
- Time trials lasting 10´, 4´ and 1´ during flat (1.0% incline) and uphill (10.0% incline) conditions
- Tests within 10 days
- Standardized warm-up
- 26“ MTB – SRM power meter (standardized upper body position)
- Cadence: 80 – 100 RPM

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Methods:

- Inverse model for CP/W´ estimation ($P = \frac{W´}{t} * CP$)
- Paired t-test
- Bland-Altman Plots

Results:

- GXT (age: 32 ± 7 years; weight: 74,6 ± 7,4 kg; maximum power output: 406 ± 39 watts; maximum oxygen uptake: 67,9 ± 3,0 $\frac{mL}{\min * kg}$)

- Comparison between uphill and flat cycling (CP and W´)

Parameter	Model	Mean difference uphill and flat	Results	
CP	Inverse	3 ± 15 watts	T_{12}=0.677; p=0.551	n.s.
W´	Inverse	1750 ± 1740 joule	T_{12}=3.626; p=0.003	s.

Results:

- Comparison between uphill and flat cycling (power output during the TT)

Parameter	TT duration	Mean difference uphill and flat	Results	
Power output	10 minutes	8 ± 14 watts	T_{12}=2.026; p=0.066	n.s.
	4 minutes	7 ± 15 watts	T_{12}=1.751; p=0.105	n.s.
	1 minute	32 ± 27 watts	T_{12}=4.397; p=0.001	s.

Discussion:

- Results indicate no sign. difference between flat and uphill cycling regarding CP
- Individual differences revealed by the Bland-Altman Plot
  - 3 participants showed a ”practical relevant” higher CP during uphill conditions
  - 1 participant showed a ”practical relevant” higher CP during flat conditions
  - Practical relevant = difference greater than 5 %

Discussion:

- Results indicate a significant difference between flat and uphill cycling regarding W´
- Sign. difference in power output during the 1 minute trial indicates a higher W´ during uphill cycling
  - High power output during short-duration work is related to a high W´
- Reliability in field conditions questionable

(Karsten et al., 2017; Karsten et al., 2014; Karsten et al., 2015)

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Take home message:

- No significant difference between flat and uphill cycling regarding CP
- Consider individual differences
- Influence of the training regime

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Thank you for your attention.